December 2011 MSS/LPS/SPS Joint Subcommittee Meeting
ABSTRACT SUBMITTAL FORM

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ABSTRACT INFORMATION

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AUTHOR INFORMATION

Author/Presenter Name: Kurt Polzin
Affiliation NASA-MSFC
Address NASA-MSFC / ER24
City Huntsville State AL Zip 35812
Telephone 256-544-5513 Telefax 256-544-2216
e-mail: kurt.a.polzin@nasa.gov

2nd Author:
Affiliation
Address
City State Zip
Telephone Telefax
e-mail:

3rd Author:
Affiliation
Address
City State Zip
Telephone Telefax
e-mail:

Additional Author(s):
Affiliation
Address
City State Zip
Telephone Telefax
e-mail:

MANAGEMENT APPROVAL

The individual below certifies that the required resources are available to present this paper at the above subject JANNAF meeting.

Responsible Manager authorizing presentation: Mr. James Martin
Title/Agency: Branch Chief/NASA-MSFC
Telephone Number: 256-544-6054 e-mail: jim.j.martin@nasa.gov Date:

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Unclassified Abstract

(250-300 words; do not include figures or tables)

Fission surface power (FSP) systems could be used to provide power on the surface of the moon, Mars, or other planets and moons of our solar system. Fission power systems could provide excellent performance at any location, including those near the poles or other permanently shaded regions, and offer the capability to provide on demand power at any time, even at large distances from the sun. Fission-based systems also offer the potential for outposts, crew and science instruments to operate in a power-rich environment. NASA has been exploring technologies with the goal of reducing the cost and technical risk of employing FSP systems. A reference 40 kWe option has been devised that is cost-competitive with alternatives while providing more power for less mass anywhere on the lunar surface. The reference FSP system is also readily extensible for use on Mars, where it would be capable of operating through global dust storms and providing year-round power at any Martian latitude. Detailed development of the FSP concept and the reference mission are documented in various other reports. The development discussed in this paper prepares the way for testing of the Technology Demonstration Unit (TDU), which is a 10 kWe end-to-end test of FSP technologies intended to raise the entire FSP system to technology readiness level (TRL) 6.

The Early Flight Fission–Test Facility (EFF-TF) was established by NASA's Marshall Space Flight Center (MSFC) to provide a capability for performing hardware-directed activities to support multiple in-space nuclear reactor concepts by using a nonnuclear test methodology. This includes fabrication and testing at both the module/component level and at near prototypic reactor components and configurations allowing for realistic thermal-hydraulic evaluations of systems.

The liquid-metal pump associated with the FSP system must be compatible with the liquid NaK coolant and have adequate performance to enable a viable flight system. Idaho National Laboratory (INL) was tasked with the modeling, design, and fabrication of an ALIP suitable for the FSP reference mission. A prototypic ALIP was fabricated under the direction of INL and shipped to MSFC for inclusion in the Technology Demonstration Unit (TDU), a quarter-scale end-to-end reactor simulator system that is scheduled for testing at NASA-GRC. Before inclusion in the TDU, the ALIP was tested in the ALIP test circuit (ATC), which is a rig developed and operated at MSFC for the specific purpose of providing accurate quantification of liquid metal pump performance. Data showing the pump performance curves (pressure, flowrate, and pump efficiency) are presented for various operating power levels, demonstrating the full performance envelope of the pump.